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Household Insects and their Remedies.

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PREFACE.

Household insects are demanding more attention today than ever before. In the careful research for the causes of human diseases it has been found that many of these pests are carriers of bacteria and disease. In addition to this, they are very annoying and also do hundreds of dollars worth of damage to clothes, household furnishings and supplies. During the past years, the author of this essay has had a great many inquiries for exterminating them. In nearly every case the housewives readily recognized the insects but were not acquainted with the best methods of control. Thus a scientific technical description of each insect was thought to be unnecessary and, in the descriptions given, the writer has tried to use such language that would be readily understood by the average housewife. Usually the housewife is not interested in the insects further than to eradicate the pests. With this in view, the writer has tried to set forth the simplest and most economical remedies for the destruction of some of the most common household insects. The author does not claim to have originated all of these remedies but they have been carefully gleaned from various sources. Nearly all of these remedies have been tried by the writer or on recommendation to his friends and have been found to be most satisfactory.

THE HOUSE FLY.

The most common and most widely distributed household pest is the common house fly (*Muscu domestica*). This insect is now attracting wide attention as a carrier of disease. It has been known to carry typhoid fever, tuberculosis, cholera, cholera infantum and dysentery and no doubt a great many other diseases.

Its early stages are passed in some moist, decaying matter, generally horse manure or barn yard filth. It is not an uncommon thing to find flies feeding on sputum and all kinds of filth; thus they pick up a great number of harmful bacteria on their feet, mouth and hairs and are carried to groceries and other eatables of all sorts. Dr. L. O. Howard has estimated that the house fly is the cause of 250,000 typhoid fever cases in America. As a general rule flies do not travel more than two or three hundred yards away from their breeding place. Bacteria have been known to live in flies for three weeks. Thus flies can distribute bacteria in a great many places without revisiting the source from which it first received its deadly germs.

Since flies are known to carry disease, it is very essential to do everything to get rid of them in our homes. Proper screening of the house is one of the first requisites. The next step should be to remove their breeding places. Manure should be removed at least once a week. Chloride of lime sprinkled over the manure each day will to a large extent prevent their breeding.

I.

Flies may be killed by using the following:

1 oz of formalin 40%
16 oz of sweet milk
16 oz of water

Pour this into a dish and set it where the flies can get at it. It is always well to float a piece of cork or blotting paper on the liquid so the flies can have more room to eat. Flies eat this readily and are killed by the thousands.

II.

The following has been used with good success:

1 cup brown sugar
1 cup of formaldehyde

Mix the two together. Should the solution dry up a little water can be added from time to time.

III.

Take an infusion of

Quassia 1 pt
Brown sugar 4 oz
Ground pepper 2 oz

To be well mixed together and put in small shallow dishes where required.

IV.

Take some jars, mugs or tumblers, fill them half full with soapy water; cover them as jam pots are covered with a piece of paper, either tied down or tucked under a rim. Let this be rubbed inside with wet sugar, mollasses, honey or jam or anything sweet. Cut a small hole in the center large enough for a fly to enter. The flies settle on the top attracted by the smell of the bait; they then crawl through the hole, to feed upon the sweet beneath. Meanwhile the warmth of the weather causes the soapy water to ferment, and produces a gas which overpowers the flies and they drop down into the vessel. Thousands may be destroyed this way and the traps last a long time.

V.

Fly traps and tanglefoot also help in reducing the amount of flies.

VI.

It is not always possible to avoid collections of manure, but these collections or piles may be sterilized successfully and made impossible as breeding nests simply by the generous distribution of sulphate of iron, in liquid or dry form. It gives better results than kerosene, for it does not harm the manure, and the cost is very light. It penetrates everywhere. By keeping constantly in the stable a barrel of this solution of a strength of about two pounds for each gallon of water and using a common sprinkler can, the sterilization would be accomplished at an approximate cost of less than 1 cent per horse per day. Making sanitary all other breeding spots, such as garbage cans and privy boxes may be accomplished by the liquid solution or dry sugar sulphate of iron being distributed freely, thus checking in the earliest stages the development of fly maggots. And this is the time for effective work, because the fly larvae or eggs are exceedingly tenacious of life. Sulphate of iron, being a deodorizer, also removes from the manure pile, the urine soaked stable drains, the outhouse and the garbage pile the pungent ammoniacal fumes and other offensive smells. Use of this chemical in cellars where rotting vegetables may be found purifies the air.

Cloride of lime is also good.

Mosquitoes.

There are a great many species of mosquitoes. They are

not only a nuisance but are also conveyors of malaria, yellow fever and denque fever. In some localities a great deal of work has been done to rid the communities of this pest. The immature stage are found in water. They breed in any place where there is open water. Rain water barrels, tin cans, water troughs and stagnant mud holes are generally the breeding places of these pests. The eggs are laid on top of the water in rafts and as they hatch the larva begin feeding upon the minute vegetable and organic matter found in the water. The first step toward exterminating mosquitoes should always be to destroy their breeding places.

Destroying Breeding Places.

One of the best methods is to pour oil upon the surface of the water. All ponds and mud puddles that can be drained should be drained. Rain water barrels and all vessels holding water should be screened. Frequently if the weeds are cut around ditches and low depressions holding water the breeding place will dry out immediately.

All tin cans should be buried or disposed of immediately. All ornamental fish ponds and water gardens should be supplied with fish that will eat the wrigglers.

Screens.

Every home should have the windows and doors thoroughly screened. Twenty meshes to the inch can be relied upon to keep mosquitoes out but fifteen to the inch is better. When mosquitoes are very numerous the screens should be painted lightly with kerosene or oil of citronella. When buying screens it will be found to be more economical to buy the brass wire screen as it will not rust out like iron wire screen. The proper housing and painting of screens will lengthen their period of usefulness materially.

Smudges and Fumigants.

Anything that will make a dense smoke will drive away mosquitoes. The writer has found that straw makes an excellent smudge for out-door parties. Campers frenquently use dried leaves. For household use other material must be used.

1.

Pyrethrin Powder.

Pyrethrin Powder can be purchased at any drug store. The powder should be heaped up on a tin pan in the form of a cone

and the tip then lighted. It burns quite readily and makes a dense pugent smoke. If the powder does not burn well it can be sprinkled over red hot coals. This method is not very effective where the windows are left open. The essential thing is the volatile oil given off into the room from the burning powder and stupifies the insect.

II.

Jimson Weed.

Dr. John B. Smith recommends the following:

1 oz of salt peter

3 oz powdered jimson weed (*Dotura stramonium*).

About ten ounces of this should be burned per 1,000 cubic feet of space. He states that the fumes are not injurious to humans, fabrics or metal. The powder should be burned on a tin pan or shovel.

III.

Nimms Culicide.

Mix equal parts by weight of carbolic acid crystals and gum of camphor. The carbolic acid crystals are melted over a gentle heat and poured over the gum. The gum is dissolved and the resultant is a clear liquid with a pleasing ordor. The vapor is not injurious to human beings except when very dense, but it will produce headache if breathed too freely. Rooms should be as nearly air tight as possible.

IV.

Protection from Bites.

One of the best mixtures to keep mosquitoes away is made from the following:

Oil of citronella	1 oz
Spirits of camphor	1 oz
Oil of cedar	½ oz

A few drops on a bath towel and hung on the head of the bed will keep the common mosquito away for a time. Where mosquitoes are real bad some of the liquid should be rubbed on the face and hands. This mixture will not last the entire night.

V.

Mr. E. H. Gane of New York remmonds the following to avoid the odor of the oil of citronella.

Castor oil	1 oz
Alcohol	1 oz

VI.

The writer has found the following to be effective:

Kerosene	1 oz
Oil of cedar	1 oz
Oil of citronella	1 oz

Place a few drops on clothes and hang them near the bed. The odor of this is not offensive.

COCK ROACHES.

Cock roaches eat any kind of food, and frequently do a great deal of damage. They are nocturnal and live in damp, dark places. generally about sinks or water places, flour bins and pantries. They have a nauseating odor and want to live around garbage. The thoughts of eating the food is intolerable. By some they are thought to be carriers of disease. There are four kinds of roaches in this country: The American Cock Roach (*Periplaneta americana Linn*), the Oriental Cock Roach (*Blatta orientallis Linn*), Australian Roach (*Periplaneta australasiae Fab*) and the German Roach or "Ceroton Bug" (*Blatella germanica Linn*).

They are wingless and all have flat, thin bodies, and strong, bitting jaws. As they live in cracks and under objects it is not easy to exterminate them. Boiling water and good soap suds will aid some in keeping down this pest. Dr. Hodges states the bat and the common toad to be very effective in exterminating this pest.

I.

Borax is the best cock roach exterminator yet discovered. The cockroach has a peculiar aversion to it, and will never return where it has been once scattered. This salt is perfectly harmless to human being and is to be much preferred.

II.

A mixture of red lead, corn meal and mollasses will be eaten eagerly by them and will soon exterminate them.

III.

Large numbers may be killed by setting out two shallow dishes, one containing flour and plaster of Paris mixed together and the other water. Use four parts of flour to one part of plaster of Paris. Arrange the dishes so that roaches can easily climb on them and from one dish to the other.

IV.

Make a strong decoction of poke roots, when the strength is out of the roots, mix the liquor with molasses and spread it on

large plates in the places they frequent. They may be thus slain by the thousands.

V.

Mix equal parts of Persian insect powder and powdered Levantic wormseed, and scatter the mixture about the places which cock roaches frequent.

VI.

Carbon bisulphite may also be used as a fumigant and will undoubtedly prove satisfactory if used in sufficient quantities. This, however, is very inflamable and one must be careful about fire.

VII.

Equal parts of 2% carbolic acid and 2 oz. gum camphor dissolved poured into cracks will get them out where they may easily be killed.

VIII.

Burning pyrethium in infested places is very effective. Room should be closed for several hours.

IX.

Phosphorus paste, which may be purchased at drug stores is claimed to be satisfactory.

X.

Scatter cucumber parings around the parts of the house troubled with these vermins.

House Cricket.

(*Gryllus domesticus Linn*)

These insects are quite common and at times do considerable damage to clothing. They often damage clothes hung in a dark and damp closet or clothespress; also hiding in fireplaces, pantries and baseboards. The house cricket shows a special fondness for liquids such as milk, and may be found in the milk pans if left uncovered. The crickets vary from brown to black according to the species. The head has two very long antennae, the hind legs are large and strongly developed for jumping. The chirping is done entirely by the male by elevating the outer wings or tegminae, and then scraping them together, one over the other, thus producing a vibration. It is supposed to be a call from the male to the female.

I.

Crickets like milk, fresh potatoes, carrots; so many are killed

by putting arsenic in the liquid and sprinkling a little on a scraped potato or carrot.

II.

Some find putting a little chloride of lime and powdered tobacco in their holes very effective.

III.

Sprinkle a little quicklime near to the cracks through which they enter the room. The lime may be laid down at night and swept up early in the morning, as it must be kept entirely away from children. This kills many of the crickets and drives them away from the house.

The Little Red Ant.

(*Monomorium pharaonis Linn*)

The origin of this species is unknown but it is supposed to have been imported. This is one of the most despised, troublesome and prolific of household pests. They nest in partitions, under floors, in all cracks and crevices where it is hard to reach them. These insects pass their entire existance in houses. They are about one-twentieth of an inch in length.

Another ant which is also a nuisance is the black ant. Ants particularly like sugar, syrup and other sweets. Ants are not so destructive to the household supplies, but their faculty of getting into everything makes them very disagreeable to say the least.

Those that are commonly known are all workers. The females stay in the colony and are known by being wingless. These wings are torn off as soon as the ants begin mating. The male usually dies and the female at once goes to her duty of establishing new colonies. Unless the colony can be reached and destroyed all other measures will be of only temporary relief.

I.

If these nests can be reached, a little kerosene or bisulphide of carbon sprayed or injected, is very effective.

II.

Fumigation with hydrocyanic acid gas is advisable in old and badly infested houses. Care must be used with this gas.

III.

To keep ants from climbing upon tables, cupboards, etc., place the legs in small dishes or pans of kerosene or water.

IV.

The writer has found it very effective to keep everything out of the way of these pests. By care they can be done away with almost as easily as flies.

V.

A few leaves of green wormwood scattered on shelves, etc., is good for black ants.

Powdered borax sprinkled in shelves, etc., will aid greatly in eradicating the pest.

VI.

Some people advise using methods of attracting the ants, such as a sponge soaked in sugar and water, and as they gather on the sponge, dip quickly in hot water. Also place a little poison is sugar, lard, etc., and some have found this effective.

Southern Cloth Moth.

(*Tincola viselliella*)

This moth is straw color without spots. The larva spins a silken web, eats hair, feathers and furs.

The Case-Making Clothes Moth.

(*Tinea peltionella Linn*)

These moths, or millers as they are called, are harmless in themselves. Their mission is to lay the eggs for the next generation. These moths are night fliers and one sees them about dusk or during the evening flying about in the dark corners of the room. They are seldom seen during the daytime except when driven from their hiding place. The adult moth is very small and delicate. It measures 2-5 of an inch when its wings are expanded. Its fore wings are yellowish-gray, marked with a few undefined brownish spots and fringed toward the outer portion of the posterior margin. The hind wings are of a uniform size, about ⅔ of the length of the fore wings. Its posterior margin has a wide fringe gradually increasing in length toward the base or wing attachment. Their minute white eggs are usually layed in some dark corner on carpets, woolen goods, furs, and etc. The eggs hatch into a small brown headed caterpillar. The larva begins feeding at once and at the same time constructing a small, bag-like case which is made of fragments of wool. The case is enlarged from time to time as the caterpillar grows. When the caterpillar is

full grown it closes up the case and goes into the pupa state. They emerge from these cases usually in July or August. There are two other species of clothes moths.

Tapestry Moth.

(*Trichophhaga tapetzella*)

The vasal half of the fore wing of this moth is white and the rest of the wing is black. The larva construct burrows in which it spins its silken lining. It feeds on coarser fabrics, tapestries, carpets, and upholestered goods.

Take equal parts of oil of camphor and spirits of turpentine. Soak blotting paper in the mixture. Let the paper dry, then lay among furs or clothing.

I.

Clothes moth is most destructive in summer, when woolen goods are stored away.

II.

Clothes should be hung out and sunned good and brushed and beaten thoroughly, then packed in a cedar chest or with cedar chips. Clothes should be wrapped in tar, paper, or bags to keep the female from laying her eggs on them.

III.

Benzine and naptha used as a spray is also good.

IV.

Upholstered furniture and rugs should be sprayed with gasoline twice a year.

V.

Naphthaline or moth balls will aid considerable in keeping these moths in control.

Carpet Beetle or Buffalo Moth.

(*Anthrenus scophulariae Linn*)

The adult insect is small, measuring about 1/8 of an inch in length. This beetle is of European origin. They breed especially on Spiraea and it is supposed they are carried into the house on the blossoms of the Spiraea and kindred flowers. The eggs of the adult female hatch out in a few days and commence feeding immediately. They show a preference for woolen goods, furs and feathers, especially places where they are stored, as they are not

so likely to be disturbed. They also live in the cracks of floors and feed on the underside of rugs and carpets. This is very destructive. They usually mature three broods yearly, according to the length of the summer.

I.

Spray carpet with gasoline and wash all cracks with hot suds and follow by gasoline.

II.

Benzine and gasoline.

III.

Tar paper on floors will keep them away.

IV.

Iron the carpet a part as a time with a wet cloth. This will kill them.

V.

Mothballs are good to pack with winter clothing.

VI.

Sulphur dioxide generated by burning flowers of sulphur is used, but it blackens silver and changes tints in wall paper, also ruins the colors in woolens.

Silver Fish Moth.

(*Lepisma sp.*)

This insect is of a silvery-gray, wingless and if touched will leave tiny scales on the fingers. These insects are about 3/8 inch long, with two long feelers or antennae protruding from the head, while there is three feelers at the hind end of the body. The pest prefers darkness, and is often found among undisturbed books, papers, or starched linens, as it exists on starchy products. As soon as these insects are disturbed, they may be seen scurrying away to hiding places.

I.

Pyrethrin dusted into places where it hides with kill them.

II.

The frequent handling of articles liable to be attacked is one of the best preventives.

III.

Naphthaline scattered among books and materials containing starchy mixtures is an excellent remedy.

IV.

Gasoline is also used very successfully, but should be used with caution where there are stoves and lights, for when used in large quantities it may cause an explosion or fire.

Book Lice.

(Atropos sp. and Clothilla sp.)

This insect is always found among old books, papers, starchy materials, and have been known to infest old mattresses. They have a peculiar ticking noise, which they make. They are so small in size, one can hardly see them, and does not really belong to the true lice in size and their foods are mainly starchy foods, while the true lice are sucking insects. The antennae is very long on these pests.

I.

The use of naphthalene in boxes and trunks will aid greatly in keeping these pests away.

II.

Infested mattresses stuffed with straw or corn husks should be ripped up and the contents burned. If the mattress is made of hair, if would pay to have it steam cleaned, thus all insects would be killed.

III.

All cracks and crevices, which are not easily reached by ordinary cleaning, should have a generous application of gasoline.

The Bedbug.

(Cimex lecturius)

The bedbug is an ancient and cosmopolitan insect. The presence of the bedbug in a house is not necessarily an indication of neglect and carelessness on the part of the housewife. This insect may gain access in spite of the best care and the adoption of all reasonable precaution. They can be carried from place to place in trunks and suit cases by travelers. This insect may migrate from one house to another. They bite during the sleep of their victim and under cover of darkness, hiding during daylight in cracks of old fashioned wooden bedsteads, under loose places in the wall paper, in crevices behind picture moulding, in picture frames, about door or window casings, or base boards. Every housewife is alarmed when she discovers the pest in her home and is always

eager to obtain an effective remedy for the extermination of the bedbug.

I.

Crude carbolic acid has been found to be one of the most effective means of destroying bedbugs. This is inexpensive and the fumes are very penetrating. The liquid should be applied with a small brush or feather in all crevices. Walls that are badly infested should be sprayed with equal parts of crude carbolic acid and kerosene.

II.

Kerosene and gasoline will aid in eradicating these nocturnal pests, but can not always be relied upon.

III.

Take everything out of the infected room, plug up all the windows tightly, close all chimneys and empty 1 oz of powdered sulphur on a pan of hot coals, placed in the middle of the floor. Shut the doors and cover all cracks; let the sulphur burn as long as it will. After the sulphur has burned out, paint all the cracks in the floor and around the base board with a strong solution of corrosive sublimate and treat the furniture to the same before replacing it. Corrosive sublimate is deadly poison and should be kept out of reach of children.

IV.

When they make a lodgement in the wall, fill all the apertures with a mixture of soft soap and Scotch snuff. Take the bedstead to pieces and treat that in the same way.

V.

Mix 2 oz. of camphor
4 oz. spirits of turpentine
1 oz. corrosive sublimate
1 pt. alcohol

This should be applied with a brush or a spring-bottom oil can to all cracks and crevices. This is a deadly poison.

Fleas.

(*Pulex serraticeps Gerv.*)

The fleas that are usually found in houses are the common cat and dog fleas. The adults are wingless. The hind legs are strongly developed to enable them to jump great distances. The

female lays her eggs loosly in the hair of the cat and dog, and are scattered wherever the animal goes. These eggs hatch out in a few days as larvae. In appearance, they resemble the maggots of the house fly, but are very much smaller. These larvae are full grown in two weeks, when they begin spinning a cocoon about themselves lying in a dormant state from 7 to 12 days, when they come out as an adult flea.

I.

The quarters of the cat and dog should be thoroughly cleaned and disinfected so the fleas will not have a chance to lay their eggs. Sometimes they multiply so rapidly, not having anything animal to feed upon, that they attack people, showing a preference for the lower limbs. The bite of the flea is very annoying to most people.

II.

Fleas will not breed in places where they are likely to be disturbed, so the shaking of rugs, carpets and thorough sweeping of floors will aid greatly in keeping them from breeding in the houses.

III.

Gasoline injected in cracks, crevices and places where they cannot be disturbed by any other means, will kill the larvae.

IV.

Creoline Dip sprayed in the cracks and corners of the kennel and on the dog will exterminate them. This should be done every two weeks.

V.

Fresh pyrethrim powder dusted over carpets, rugs and sofas will afford relief. This powder should be left several days before sweeping it up.

VI.

Insect powder dusted throughly into the animal's hair will cause the fleas to drop off.

VII.

Dogs should be given a lathery bath of warm water and carbolic soap.

VIII.

Flower of sulphur contains sulphurous acid and is fatal to this pest, but care must be taken not to use it near colored flannels as it often destroys the color.

Head Lice.

(*Pediculus capitis De G.*)

This is the most common insect that attacks man. It receives its name from being found on the head, although it sometimes is found on the hairs of the beard. It is parasitic in habits, and belongs to the same order as the bedbug. They puncture the scalp and suck the blood. The nits or eggs adhere very closely to the hairs and are found some distance from the scalp. These eggs hatch in two weeks and are very prolific.

I.

The louse may be combed out of the hair with a fine comb. Kerosene put on the roots of the hair will kill all nits and the adult louse.

II.

Mercurial ointment is very effective.

III.

Vaseline is another that checks this pest by clogging up the breathing pores. Whatever remedy is used, should be kept up every two or three days for at least twenty-one days.

Termites.

(*Termes aavipes Koll.*)

Termites, or white ants, as they are sometimes called, are not really a true ant. They have nests and live together similar to the ants but live on decayed wood and vegetable matter. The workers are white, blind, wingless, sexually undeveloped insects. The winged males and females are produced each spring but their wings are not strongly developed, so they are poor flyers. They usually nest in a hollow stump or other infested material. The winged males and females are blackish in color and resemble the true ants, except the crossviens in the wings. They reproduce yearly in the spring.

I.

If this pest infests a building, the surest way is to tear off the pieces that are infested as they bury themselves in the wood and cannot easily be reached by fumigating.

II.

Wood soaked in creosote is excellent in keeping them away.

III.

The greatest difficulty is finding the nest as they tunnel all through the wood, but fumigating with carbon bisulphide is good if one can reach the seat of trouble.

IV.

Gasoline poured into the burrow will destroy them.

BACON OR HAM BEETLE.

(*Dermestes lardaris Linn*)

This insect is about 3-16 in. long and 1/8 in. broad. The lower half of the wing covers are covered with grayish-yellow scales, with several small black spots on the wings, which sometimes form almost an entire band across the beetle. This insect is always recognized by its feeding on bacon, ham, lard and cheese. It especially like the fatty portions of the ham. The adult female beetle begins laying her eggs in the spring on meats or nearby, so that the newly hatched larvae may crawl to the meat. The full grown larva are about 9-16 in. long. When full grown, they bury themselves in meat and cheese, and change to the pupa stage. They stay in this state from 3 to 5 days, according to conditions. These beetles reproduce about every six weeks.

I.

If these beetles are found in the meat, the best remedy is to cut away the infested parts and wash in a weak solution of carbolic acid and water, or the good parts may be sliced and fried, lay the pieces in a stone jar and pour over hot lard and cover.

II.

Some find spraying with benzine to be very effective method for destroying the larvae.

III.

Fumigating smokehouses and storerooms with carbon bisulphide or hydrocyanic acid gas will rid the building of this pest Hydrocyanic acid gas is very dangerous so great care should be taken in handling it.

IV.

The smokehouse should be screened in order to keep it insect proof. The mesh should be fifteen to the inch.

Bean Weevil.

(*Acanthoscelides Bruchus obtectus Say*)

Dried beans that have been stored away for the winter supply are the ones most affected. Many of the beans showing round holes are where the adult weevils have matured, some may contain small grubs, while in the lower part of box and in corners will be found these small weevils, about 1/8 inch in length. They are of a brownish, spotted color. New beans may be infected from a few old beans of last year's crop, or by the eggs being deposited in the beans while on the vine.

Fumigation with carbon bisulphide or carbon tetrachloride is the best treatment and should be applied as soon as beans are gathered. Never plant infested beans.

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Aquatic Life: With Special Reference to Entomostraca.

BY JOSEPH STACK.

The present paper is the result of a zoological survey of Beimiller's Cove, Cedar Point, Ohio, and of numerous ponds and streams in that vicinity, nearly all the work being done on invertebrate forms. The chief problem was on the habitat of Entomostraca and the environic conditions affecting them. The forms most abundant in the cove, and most often observed, belong to the two sub-classes *Phyllopoda* and *Copepoda*. The nauplius stage was considered by itself at all times.

During the summer, several trips were taken to neighboring bodies of water and the data gathered on these trips is included in this survey.

Cedar Point is a peninsula, not over one mile wide at its widest point, extending eastward for seven miles into Lake Erie from the north-central part of Ohio, separating Sandusky Bay on the south from Lake Erie on the north. Cedar Point proper is located at the end of this peninsula and Ohio State University Laboratory is located two miles east of Cedar Point on Beimiller's Cove, at which place most of this survey was made.

Beimiller's Cove is situated in an ideal place for studying aquatic life. It is separated from Lake Erie on the north by Cedar Point, which is one quarter of a mile wide at this place. On the south it is separated from Sandusky Bay by a narrow peninsula about one half mile long which is an extension from the Point proper. The west portion of the Cove cuts into the Point ending in a marsh. The Cove opens into Sandusky Bay on the southeast side. With such aquatic surroundings the opportunity for a comparative study is unlimited, a point that will be considered in the survey.

To obtain more accurate data on the habitat and environic conditions affecting the Entomostraca in Beimiller's Cove, stations were established where different environmental conditions prevailed and these places were subjected to careful study. These stations were visited every day and the day following the visits was spent in the laboratory identifying and determining the specimens collected. On account of the large area of the Cove it required a whole day to make the complete trip to all the stations.

Station I is located in the extreme north-west corner of the Cove and marked by a long pole driven solidly into the bottom at this place. The water is very shallow, 1¾ feet deep. The bottom is covered with decomposed plant life, consisting chiefly of water lily pads and bulrushes. Owing to the shallowness the temperature of the water varies directly with atmospheric changes. As in all shallow water, the temperature remains constant or usually tends to constancy throughout the slight depth according to the changes of air temperature. The shore at this point is covered with ferns and short grasses forming a swampy undergrowth. Owing to this form of vegetation there is little protection from the sun.

Station II is similarly situated near the shore which is swampy and sparsely protected by shade. The water is slightly deeper than at Station I, being 2⅔ feet deep. Other characteristics are similar to Station I. A large water-soaked log extending from the swamp makes a very stable land mark for this station.

Station III is one of the most interesting points studied, being located in the mouth of a sewer channel which carries all the sewage from Cedar Point and empties part of it into the Cove. The remainder is carried, by a deepening of the channel to 4 feet, into Sandusky Bay. Station III is located in the extreme south-west corner of the Cove at the entrance of the sewer channel into the Cove. At this point the water is 3 1-6 feet deep and is extremely turbid, caused by sewage. There is a decided current produced here and continues to the Bay owing to the fact that the channel is several feet deeper than the surrounding water of the Cove. Due to this and to the great force that propels the sewage into the channel, the current is very strong and vegetation is not given a chance to grow as it does in the quiet water of the rest of the Cove. This current produces a fluctuation of forms and numbers at this station. The bottom is covered with a deep black slime. The water is protected from the sun by shrubs and small trees extending from the bank of the peninsula on the south.

Station IV is midway between Station III and the end of the Cove on the south side, being too far from the sewer channel to be noticeably affected by it. The bank slopes gently to a height of about 5 feet on the top of which there is a slight second-growth of trees which furnish considerable shade for this station. The bottom is rather sandy and free from abundant vegetation and is gradually

sloping in toward the center of Cove. Depth is 2 feet; marked by tree on peninsula.

Station V is one of the deepest parts of the Cove, 5⅔ feet deep. The bottom is covered with a deep, soft layer of sandy loam on which grows an abundance of vegetation, chiefly *Myriophyllum* and *Ceratopyllum* which grows so rapidly that by August 25th it is impossible to row a small boat through the Cove. These forms first start submerged and later cover the entire surface. This station being located in the center of the Cove is noticeably affected by wind and currents. In early summer, before the vegetation has become too abundant, the water is clear.

Station VI is south-east of Station I on the same side of Cove. The bottom is covered with decomposed plants making a mucky covering over sand. Underbrush covers the shore, back of which is a small wood which furnishes shade to the shore at this station. It is 1⅓ feet deep; marked by dead tree on bank.

Station VII is located about 10 feet south of Laboratory Point in a swampy region, the water being 1¾ feet deep. The bottom is composed of sand covered with muck. The shade is sparse.

Station VIII is midway between Laboratory Point and the end of the peninsula on the south, at the opening of the Cove into Sandusky Bay. This is the deepest part of the Cove, 6½ feet. There is abundant vegetation as at Station V. The bottom is mucky and the wave action quite pronounced. No shade.

Station IX is near the shore, at the extreme east end of the narrow peninsula on the south. The water is shallow at this point being only 1 1-6 feet deep. The bottom is sand covered with scant vegetation. The peninsula ends at this point as a sand bar. .

All observations and collecting was done by the aid of a big, heavy, flat bottomed row boat which was 12 feet long and 3 feet wide, having very low sides. It had to be quite large in order to carry the necessary equipment, to give ample room for taking the readings, and for preparing collected material for safe transportation to the laboratory. The heavier the boat the less chance for drifting from the point of operation. Having a flat bottom there was very little chance of rocking and it presented a plain surface on which could be placed bottles, jars, etc. Having low sides, 5 inches above the water surface, it facilitated the work of handling the nets, taking temperature readings and making observations along the bottom.

The carbon dioxide content of the water was determined by titration. On the seat in the stern of the boat was carried a case which contained all the requisites for making the analysis of carbon dioxide content. It contained a small bottle of indicator to which was attached a tube with a spring clamp which kept the bottle air tight and facilitated the using of the indicator. Another bottle similarly equipped contained sodium hydroxide. A test bottle was lowered to the bottom of the Cove by means of a long, stout cord. To the neck of this bottle a weight, heavy enough to submerge it, was attached. To the cork was fastened a stout cord by means of which the water-tight bottle could be opened after it had reached the desired depth. The carbon dioxide content was taken as follows: the test bottle was made as free from air as our means would permit and the stringed-cork tightly inserted. The bottle with weight and cord attached was lowered into the water to the desired depth and the stringed-cork was pulled allowing the water to enter until the bottle was completely filled. Then it was drawn gradually to the surface and corked to keep the air from entering. Before the titration was made the top portion was quickly poured off to obtain more accurate results and 1000 c. c. taken from the remainder. To this a few drops of indicator was added drop by drop and the number of c. c. required to color the solution a delicate pink determined the amount of carbon dioxide present in 1000 c. c. of water. On a following page the results are given. These readings were made only on two trips owing to the amount of time it required to make them and to the fact that the presence of the carbon dioxide was practically constant for the length of time we were working on this problem.

All temperatures were taken by means of an accurately adjusted and tested deep sea thermometer. Four readings were taken at the nine stations every trip; air and water temperature at the surface, water temperature one half distance to the bottom, and on the bottom.

The turbidity was taken by the use of a very simply constructed turbidimiter made of a Mason jar cover in the top of which was the customary porcelain disc. To the sides to this cover were attached three strings which were tied at a point 4 inches above the cover. This method of attachment kept the white porcelain disc parallel to the surface. From the three strings extended a long extension which was used for lowering the cover from the

boat. The turbidimiter was lowered in a horizontal position and the depth at which it entirely disappeared from view was noted. It was then slowly raised again and the depth at which it reappeared noted. The mean of these two measurements was taken as the depth of its visibility beneath the surface. This turbidimiter was used at each station.

For collecting purposes towing nets, made of fine silk bolting-cloth were used. These nets were 18 inches long and conical, the base or entrance being 8 inches in diameter and held open by a wooden hoop. Three cords were attached by the same method used on the turbidimiter. The apex or outlet of the net was ½ inch in diameter and to this end was tied a small vial 2 inches long and ½ inch in diameter. On the neck of each vial there was a flange which facilitated the tying on of the net. Fifteen of these collecting vials were used on each trip and were carried in a box specially made for them. New corks were always used and at each station the date, number of towing, and a letter representing the kind of towing was written with water proof ink on each cork which was then inserted into a corresponding vial. See chart number 1 for method of keeping this data.

Field notes were kept in a water-proof covered notebook and the form on the following page was used in recording observations at each station.

Date....., 1916. Time of day..... Air temperature..... Wind: Direction..... Velocity..... Water Temperature: Surface ..... ½ distance to bottom..... Bottom..... Sky..... Turbidity..... Carbon dioxide.....per 1000 c. c. Bottom condition.....

The following terms were used for description of:

Wind.		*Sky.*	
Not perceptible	N. P.	Clear	Cl.
Calm	C.	Hazy	H.
Moderate	M.	Cloudy	Cd.
Light Breeze	L. B.	Foggy	F.
Strong Breeze	S. B.		

Plant Life		*Character of Bottom.*	
Abundant	A.	Sandy	Sn.
Sparse	S.	Mucky	My.
Absent	Abs.	Clayey	Cly.

On each trip it was necessary for one man to row the boat and keep notes while the other made the observations. To avoid

variations in the readings the same man made all the observations while the other rowed the boat.

We usually started out at 9:30 a. m., and at each station the following procedure was carried out. On arriving at the station a heavy anchor was dropped to the bottom to hold the boat at a fixed point. Then the form for keeping the data, previously described, was filled out. The towings were made as follows: first the tow net with vial attached was weighted and buoyed sufficiently to emerse the net and vial to the desired depth. This was attached to a rope 100 feet long. The boat was then rowed 100 feet and then anchored and the net with vial was gently pulled to the boat. This gave us sample No. 1, horizontal towing at the surface. The cork was marked accordingly and inserted into the vial. A note of vial was made in record book. Owing to the shallow water at some of the stations only the one towing was taken but at other stations where the depth of the water was greater, the surface, one half the distance to the bottom and bottom towings were taken and marked accordingly. The complete trip was generally finished at 3.00 p. m., and the material brought to the laboratory for preserving. Four drops of formaldehyde and two or three of glycerine to each vial served as best preservative. The vials were placed on a special, private table and were not molested. The examination of material was made next day.

FIELD NOTES

CHART I

Date....6-29-16. Time....9:32 A. M. Sky....Hazy.

Station No.	I	II	III	IV	V	VI	VII	VIII	IX
Cent. Temp. at Surface	27.5	27.5	29.	28.	28.	28.5	28.	27.	27.
½ Dist. to Bottom	27.5	27.	29.	28.	28.5	28.5	28.	27.	27.
Bottom	27.5	27.	28.5	28.	26.	28.	28.	26.	27.
Depth	1′9″	2′8″	3′2″	2′	5′8″	1′4″	1′9″	6′2″	1′2″
Time a. m.	9:45	10:00	10:20	10:40	p.m. 1	2	2:15	2:30	3
Wind Direction	N.W.	S.W.	S.W.	S.W.	S.W.	S.W.	S.E.	S.E.	S.E.
Wind Velocity	L.B.	L.B.	L.B.	L.B.	L.B.	L.B.	L.B.	S.B.	S.B.
Turbidity	1′9″	2′8″	8′	2′1″	3′8″	1′8″	1′9″	3′1″	1′2″
Air Temperature	27	27	27	27	26	26	26	26	25
CO_2 Cont. No. c.c. per M.	3	0	20	2	10	0	0	7	2

Vial No.	*Location*
I	Horizontal Towing from station I.
II	Horizontal Towing from station II.
III	Horizontal Towing from station III.
IVa	Horizontal Towing at surface from station IV.
IVb	Horizontal Towing ¼ D. to B. from station IV.

IVc	Horizontal Towing at bottom from station IV.
Va	Horizontal Towing at surface from station V.
Vb	Horizontal Towing ¼ D. to B. from station V.
Vc	Horizontal Towing at bottom from station V.
VIa	Horizontal Towing at surface from station VI.
VIb	Horizontal Towing ¼ D. to B. from station VI.
VIc	Horizontal Towing at bottom from station VI.
VIIa	Horizontal Towing at surface from station VII.
VIIb	Horizontal Towing ¼ D. to B. from station VII.
VIIc	Horizontal Towing at bottom from station VII.
VIIIa	Horizontal Towing at surface from station VIII.
VIIIb	Horizontal Towing ¼ D. to B. from station VIII.
VIIIc	Horizontal Towing at bottom from station VIII.
IXa	Horizontal Towing at surface from station IX.
IXb	Horizontal Towing ¼ D. to B. from station IX.
IXc	Horizontal Towing at bottom from station IX.

A qualitative and quantitative microscopical analysis was made of the contents of each vial. Three slides were made from each sample and the kinds and quantity of forms noted. The average number of each form on three slides was recorded as on Chart II.

6-29-16 CHART II

Vial No.	Bacteria	Algae	Diatoms	Arcella	Nauplius	Bosmina	Cyclops	Cypris	Chydorus	Simocephalus	Daph'a
I	sparse	sparse	0	1	6	12	38	14	12	12	2
II	sparse	sparse	6	3	23	0	5	5	3	0	0
III	abundant	absent	20	0	45	0	9	2	10	0	0
IVa	abundant	absent	2	2	9	4	24	11	0	3	7
IVb	abundant	present	12	8	2	2	14	19	10	8	1
IVc	sparse	present	10	6	5	17	6	3	12	1	0
Va	sparse	present	12	5	41	5	9	0	8	0	0
Vb	sparse	abundant	0	0	7	3	4	14	3	6	2
Vc	sparse	abundant	14	8	1	2	1	10	0	2	0
VIa	sparse	abundant	4	3	48	40	34	18	12	14	3
VIb	abundant	abundant	9	7	2	12	24	16	7	5	0
VIc	sparse	sparse	18	9	7	1	9	4	0	2	0
VIIa	sparse	sparse	0	1	16	1	2	12	8	7	1
VIIb	sparse	sparse	2	0	8	1	3	8	12	3	2
VIIc	absent	abundant	5	2	7	3	0	7	0	0	0
VIIIa	absent	abundant	0	0	5	3	0	6	3	2	0
VIIIb	absent	sparse	0	0	4	2	1	1	0	3	1
VIIIc	sparse	present	7	3	2	4	6	5	3	0	0
IXa	absent	sparse	0	0	2	4	2	0	1	2	0
IXb	absent	sparse	3	6	7	10	7	6	0	5	1
IXc	absent	absent	12	15	0	3	1	12	6	0	3

Chart I represents the data taken on the following days in 1916. June 22, 23, 29. July 7, 13, 21, 24, 26, 28. August 2, 4, 8, 16, 22. On each trip a similar chart was used and at the end of the summer the average temperature, turbidity and carbon dioxide content was calculated. Chart I shows the average at each station. Thus fourteen charts similar to I and II were made, denoting fourteen trips to each station and from the data taken at each station the following conclusions were drawn.

Stations I and II. Very shallow; temperature variable; bottom covered with decomposed plant life. The Entomostraca which feed on plants, desmids, diatoms, etc., were quite abundant. The greater the rainfall the more abundant the Entomostraca at all of the stations. 3 c. c. of carbon dioxide per 1000. No effect on forms found at such a low per cent.

Station III. Comparatively deep. Carbon dioxide content high, 20 c. c. per 1000. Bacterial growth abundant. Numerous Entomostraca in nauplius stage. Adults found more numerous at Station IV where vegetation was more plentiful. The number and genera fluctuated from day to day due to the current from the sewer channel.

Station V. This station was one of the deepest in the Cove and although fewer forms were found here their number and kind were more constant. It was found by taking three horizontal towings that the Entomostraca tend to be uniformly distributed in a horizontal plane having the maximum number about 2 feet below the surface and the minimum at the bottom. The nauplius stage appeared first in the upper waters of the Cove quite near the surface. Increase in population results in extension downward, and the mass becomes most uniformly distributed at its maximum developement. With decline of production there is a relative increase in numbers in the lower waters. Common sunfish (*Eupomotis gibbosus*) were feeding on the surface forms.

Station VI. Located near shore having similar surroundings and environment that existed at Stations I and II. The forms frequently found here were Daphnia, Simocephalus, Chydorus. Sunfish had built their nests at this point and fed upon these forms. It is estimated that one *Daphnia pulex* (female) may have a progeny of 13,000,000,000 in sixty days. It is little wonder then that the Entomostraca form one of the chief foods for fishes. It was also noted that when large numbers of Daphnia occurred and a cloud

would shade the rays of the sun these forms would come nearer to the surface and with the passing of the cloud the forms would descend.

At Stations VII, VIII, and IX, which were at the outlet of the Cove all the forms fluctuated owing to the wind currents producing waves. Especially was this true when the wind came from the south or the southeast. On calm days the greater numbers were found near the surface while on windy days they were entirely absent or only a few near the bottom. Very seldom was the nauplius stage found at this station.

At Stations I, II, VII, and IX, the water was shallow and the temperature remained constant or would tend to constancy throughout the slight depth, depending upon atmospheric changes. At these stations the forms were found to be numerous on warm, bright days but very few could be found on cool, dark days; at such times they were more numerous in deeper water where less fluctuations in temperature occurred. Greater fluctuations occurred in the narrow Cove which was also shallower, than in Lake Erie or in the abandoned quarry pond to be described later, both of which were considerably deeper.

This sums up only a very minute portion of such a vast problem and only a few conclusions have been drawn. In addition the following data was collected on trips taken to neighboring bodies of water and also on some other observations made in Beimiller's Cove.

Blue Hole, Castalia.

Blue Hole is located at Castalia, Ohio, which is about six miles southwest from Sandusky, Ohio, close to the Big Four R. R. tracks.

A party of four made observations and collected material from Blue Hole, July 3rd, 1916. We arrived at this place at 10:45 a. m., the weather conditions being ideal. The sky was clear, the sun hot and the wind very perceptible.

The Hole is 80 feet long, 64 wide and about 45 deep; having two small outlets about 3 feet wide, leading from either side. It is surrounded by a narrow path about 2 feet wide and surrounding this there is thick vegetation, 6 inches to 3 feet high. Extending from the bank, out about 2 feet on the top of the water there is a shelf of plant life made up of moss, chara, algae, spirogyrae, and other forms intermingling.

On this particular day we found the water to be exceedingly clear and blue. This blue color is probably due to the blue-green algae and great amount of sulphur present. The Hole is fed by springs which, on some days, bubble up to the surface. The water is ice cold and very odorous of sulphur. Workmen, who get drinking water there, say that when the springs are bubbling it is impossible to see the bottom owing to the great agitation. The sides and bottom are composed of marl and only a slight growth of vegetation occurring on the sides near the top, was found.

From the two streams leading from the Hole, numerous trout are caught every year but in the Hole itself animal life is very sparse. We could see no fish but found one stickleback underneath the plant shelf. The keeper of the Castalia Fishing Club said that he had seen trout swim across Blue Hole with mouth out of water and then jump on to the land. From these facts we drew the conclusion that there is but very little free oxygen present.

From the shelf which covered the water for about two feet from the shore towards the center, pieces of the shelf, 1 foot long by 6 inches wide, were taken from the Hole and examined. The first piece was taken from a point nearest the center of the Hole. It was made up of moss and algae. On the under surface there were found numerous snail eggs but only a few adult forms. Located in the mat there were *Gammarus* and snails. Very few forms were found on the top of the mat.

The second piece was taken from a point close to the shore and the odor from this piece was very strong of sulphur. Few forms were found on the surface and on the bottom but in the mat the following forms were found: numerous insect larvae, snail eggs, leeches and *Gammarus; Asellus* sparse, and only one earthworm.

The third sample, taken from the mat next to the shore, was made up of chara. In this the *Gammaridae* and *Asellae* were abundant. Also found *Simulium* larvae. In a piece of *Spirogyrae* mat taken from a similar point numerous *Annulates* were found.

A sample of moss taken from the Hole at the upper end had very little life on it, one earthworm being found.

Sample number 5 was taken from near the shore and was made up of mint, moss and other plants and it was found to be sparsely inhabited; a few snails, leeches, and insect larvae. Three pieces of moss, the size of the hand, were taken next and examined and the following were found:

A.....7 Gammaridae.
B.....13 Gammaridae.
C.....14 Gammaridae.

From a piece of chara the same size:

A.....3 Gammaridae.
B.....4 Gammaridae.
C.....4 Gammaridae.

The moss seemed to be the most desirable. The gray colored type which is the larger was found, as a rule, nearest the shore. These *Gammaridae* also live near the surface. Other forms found were earthworms, snails, *Asellus* (few) and *Hydrophilous* beetles (few). In the protected place along the shore a great many *Physa* were found on the algae.

On another lump of moss the size of the hand we found 21 leeches, 5 snails, 2 earthworms, 1 beetle, 10 *Gammaridae*.

From the preceeding data we drew the following conclusions:

1. Life scarce, due to lack of oxygen.
2. *Gammaridae* most numerous of forms found, being most abundant near the surface and in the plant life along the shore.
3. Algae and moss plentiful, furnishing abundant food for plankton.

Towings were taken at the surface (Tw. 1); (Tw. 2) ½ the distance to the bottom and in these the following forms were found:

Tw. 1.
Diatoms (abundant).
Spirogyrae (sparse).
Blue-green algae (abundant).
Roundworm (Nais 1).

All smaller protozoans absent. A few Desmids found.

Tw. 2.
Spirogyrae (sparse).
Cypris.....4.
Annulates.....3.
Insect larvae.....2.

On August 3rd. we took the following readings, the carbon dioxide content being taken about 10 feet below the surface:

Reading No. 1.....50 c. c. per M.
Reading No. 2.....60 c. c. per M.
Reading No. 3.....60 c. c. per M.

The depth of the water near the log on the west side is 32 feet. The depth in the depression on the east side is 29 feet.

The temperature at the lower outlet was 41.3 F. The temperature around the shelf where the water is more stagnant than at the outlet was 60.8 degrees F.

BEIMILLER'S COVE, CEDAR POINT.
July 5, 1916.

A strip of shore water 100 feet long and 30 feet wide along the northwest corner of the Cove was examined for aquatic forms. The temperature of the water was 27 degrees C., and this was constant throughout the slight depth of 2 to 3 feet.

The flora found consisted of willows along the shore, *Myriophyllum* and *Ceratophyllum* just below the surface, roots of grasses and trees along the shore, and reeds throughout the space covered.

On the surface of the water along the shore were found adult mayflies and midges while adult *Lepidoptera* were flying over the water. There was an abundance of vegetation near the shore and this accounts for the mucky bottom at the east end of the Cove. Leeches (*Glossiphonia*) were found to be numerous and *Asellus* were abundant.

In the mud and under the surfaces of leaves and in among the roots along the shore the *Gammaridae* were numerous. Also found large egg masses of *Polyzoa*, pupae cases, *Oniscus*, leeches, and snail eggs.

On the reeds which were all growing from a sandier bottom, leeches, water mites, snails, polyzoans and snail eggs were found. On all vegetation in this locality polyzoans were found in abundance. *Gammaridae* most numerous on myriophyllum and algae.

On the bottom along the northeast side of the Cove a few mussels (*Lampsilis*), numerous snails at a depth of 2½ feet; and sunfish nests at 2 to 3 feet were found; also a few crayfish.

The air temperature during the collecting period was 27 degrees C. and the water temperature 25 degrees.

SUNFISH NESTS—BEIMILLER'S COVE.
July 5, 1916.

The sunfish build their nests along the shore in shallow water, where the bottom is unusually sandy and free from vegetation.

The nest consists of a saucer-like depression having the bottom lined with small pebbles. These pebbles may be the result of the fanning, described later on, or they may be the result of wave action.

In the process of building the nest the fish clear the desired location by swimming around and around the spot in a very methodical manner; swimming clockwise three or four times then erecting the body and using the tail as a fan or broom to clear away the vegetation and other foreign substances; then they swim counter-clockwise for three or four times and go through the same process of sweeping. At regular intervals, usually after four complete cycles, they dart out to survey the surroundings for enemies, etc.

They are gregarious in their nest building habits. We found anywhere from 6 to 14 in a colony in the Cove.

MARSH POND—KELLEY'S ISLAND.

July 8, 1916.

Large marsh pond located about 75 yards from Lake Erie. Great abundance of vegetation consisting of algae and spirogyrae. The bottom was covered with a deep mud. The following forms were found: beetles, water striders, snails, few *Gammaridae* and tree toads. Back swimming beetles, *Hydrophylidae*, *Dytiscidae;* numerous crayfish, minnows, frogs amid the vegetation, leeches and *Rhyncophoridae*.

This marsh was formerly a celery bed but now kept moist and marshy by springs and seepage from the lake.

ROCK BOTTOM POND—KELLEY'S ISLAND.

July 8, 1916.

The pond was originally a quarry and has been blasted out at least 14 years ago. It measured 100 feet wide and 120 feet long. Rocky bottomed and rock bound. Turbidity 9 inches. One corner was covered with grass and willow bushes. Abundant algae and spirogyrae around the edge.

On the surface were found water striders, *Gyrinidae*, back swimmers, *Notonectidae*, midgepupae, diptera larvae, fish, turtles, toads, leeches and snails. Also found an Oligocheat (*Lumbriculus*) close to the rocks in spirogyrae.

In a surface towing taken from a point 10 feet from the shore along the bottom the following forms were found:

Cyclops.....75.
Cypris.....26.

Numerous *Colpoda* which resembled *Paramecium* only smaller.

LAKE ERIE AND SANDUSKY BAY FARMS.

July 17, 1916.

Comparison of plankton in Lake with that in Bay.

No. 1 Tw. in Bay.

1. *Ceratium* (numerous).
2. *Nauplius* (numerous).
3. *Cyclops.*
4. *Annulata* (*Stylaria lacustria*).
5. *Rotifera.*
6. *Diatoms* (Asterionella).
7. *Arcella discoidea.*
8. *Bosmina* (few).
9. *Amoeba proteus.*

No. 2 Tw. in Bay.

1. *Bosmina.*
2. *Nauplius* (numerous).
3. *Cypris* skeleton.
4. *Ceratium* (numerous).
5. *Rotifera.*
6. *Peritricha* (*Podophrys*).
7. *Diatoms.*
8. *Daphnia hyaline.*
9. *Cypris.*
10. *Closterium.*

No. 1 Tw. in Lake.

1. *Monostyla.*
2. *Ceratium longicorne.*
3. *Difflugia lobostoma.*
4. *Bosmina striata.*
5. *Nauplius.*
6. *Diatoms* (Asterionella).

No. 2 Tw. in Lake.

1. *Difflugia lobostoma.*
2. *Ceratium.*
3. *Diatom.*
4. *Algae.*
5. (Fish).

From the preceeding comparison we find that the planktonts are more numerous in the Bay than in the Lake and in the Lake they are more numerous a distance out where the shore does not affect the occurrence than they are near shore. For self preservation the planktonts avoid the battering action of the waves along the shore.

Pipe Creek, Sandusky.

July 19, 1916.

Pipe Creek is a typical rock-bottomed stream which begins in a marsh near the Bay and empties back into the marsh. The stream is about 15 feet across and a sewer empties into it at the bridge near the Soldiers' Home, from where we started. The vegetation consisted chiefly of algae which was directly in the stream. Also found live crayfish and many small minnows.

Vegetation covered with *Eucrangonyx* and beetles; damsel fly larvae were also quite abundant; small cat fish, dragon fly larvae, several snails, cat fish fry and the numerous skins of crayfish which had been shed.

Towing No. 1 was taken below the bridge along the shore. The current was moderate; depth about 8 inches; sewer contamination present. Air temperature 32 degree C. Water temperature 32 degrees C. Found *gammarus, diatoms,* and *arcella.*

Towing No. 2 was taken from a quiet pool banked off from the

main channel by rocks. Found *cyclops, arcella, difflugia* and *diatoms*. Life very sparse.

Towing No. 3 was taken from a quiet pool in the creek below the cemetery, the spot being well shaded. Contamination from all the sewers from the cemetery and below was present at this point. No vegetative forms were present.

1. *Annulata* (*Nais*).
2. *Amoeba proteus.*
3. *Diatoms* (numerous).
4. *Rotifera* (*Brachionus entzii*) numerous.
5. *Paramecium.*
6. *Arcella.*
7. *Euglenoidea* very abundant and this is indicative of sewage contamination; encysted forms abundant also.

More forms found here and the species were more numerous than at the points from which the two preceding towings were taken.

Down about 150 feet the vegetation was chiefly of a chara-like plant. Rapids were located below the second point of collection. In the rapids we found snails (numerous) larvae cases of midges, nematodes, beetles.

From rock on bottom: plannaria, caddice fly cases, bryozoan, snail eggs, fly larvae, egg case of water beetle, leech and hydra.

Air temperature was 30 degree C. and that of the water was 35.

LAKE ERIE PLANKTON.

July 27, 1916.

Towing No. 1 at surface.

3 *Vorticella* on blue-green algae (Anabaena Flos-aquae).
2 *Diatoms.*

Towing No. 2. ½ distance to bottom—10 feet.

12 *Nauplius.*
2 *Cyclops.*
1 *Bosmina.*
18 *Vorticella* on *Anabaena Flos-aquae.*

Towing No. 3 taken from the bottom—20 feet.

4 *Daphnia hyalina.*
65 *Cyclops.*
20 *Nauplius.*

There were few forms found at the surface, more numerous at the middle and bottom, greatest number at the bottom. The adult cyclops most numerous at the bottom while the nauplius stage was found to be most abundant ½ distance to the bottom.

Vorticella seemed to be very fond of the blue-green algae, *Anabaena flos-aquae*.

SANDUSKY BAY PLANKTON.

July 27, 1916.

Towing No. 1 at surface.	*Towing No. 2 ½ distance to bottom.*
Cyclops.	*Ceratium.*
Nauplius.	*Cyclops.*
Ceratium (numerous).	*Difflugia.*
Vorticella.	*Daphnia kalbergensis.*
Rotifera (numerous).	*Nauplius.*

Great abundance of animal life throughout Bay.

STARVE ISLAND.

July 25, 1916.

Starve Island is located about 20 miles from Cedar Point and about one mile from Put-in-Bay. The island is made up of about ¾ of an acre of limestone and only a slight amount of vegetation occurs on the northeast corner (Platell).

This island is the nesting place of both the common and black tern and all ages of the birds were found. The youngest ones were found protecting themselves from the sun's heat by keeping in the shade of rocks. This was also a striking example of protective coloration. Found one garter snake and this was the extent of life on the island.

ABANDONED QUARRY—MARBLEHEAD, OHIO.

July 15, 1916.

Abandoned quarry at Marblehead, three or four years old, a typical rock bottom pond. Observations and reading were taken at three stations. Breezy and very bright sunlight.

Station 1.

Located about 50 feet above dock near the center of the pond. Rocky bottom and only a slight trace of algae. Depth 7 feet, 4 inches.

Temperature.

Surface	28 C.
½ dis. to bottom	27 C.
Bottom	21 C.

Carbon dioxide content.

At surface	1 c. c. per M.
At bottom	7 c. c. " "
2 ft. below surface	5 c. c. " "
7 ft. below surface	5 c. c. " "
½ ft. below surface	3 c. c. " "

No. 1 towing taken from the surface.

No. 2 towing taken from the bottom.

No. 3 sample was taken by pumping from the bottom into a net which was tied at the narrow end or outlet of the pump and then the net was carefully washed.

No. 4 towing taken from the bottom.

Station 2.

Located just off the dock. Depth 10 feet. Turbidity 9 feet.

Temperature.

28 C. at surface.
27 C. ½ distance to bottom.
27 C. at bottom.
No carbon dioxide present at surface.
2 c. c. per M. at bottom.
1½ c. c. per M. 7 feet below surface.
7 c. c. per M. 5 feet below surface.

No. 5 deep towing off dock.
No. 6 surface towing off dock.
No. 7 ½ distance to bottom from dock straight across to other side.
No. 8 surface towing from side to side.

Station 3.

At entrance of undercut from Lake through which undercut the pond is kept supplied with water. This point is supposed to be the deepest part of the pond but sounding proved that the pond was the same depth throughout.

Depth.....7ft. 4in.
Turbidity.....7ft. 4in.

Temperature.

28 C. at surface.
28 C. ½ distance to bottom.
27 C. at bottom.

No. 9 deep pond dredging.

Carbon dioxide.

At surface.....1 c. c. per M.
At bottom.....5 c. c. per M.

Sunfish were found in the pond and also one stickleback. These fish had been thrown into the pond by fishermen. In pools, cut off from the main part we found water beetles and water striders. In pools not quite cut off from the shallow pools we found an abundance of algae upon which there were numerous beetles (*Hydrophyllidae*) and many small snails. Given below is a summary of the different towings with forms, quantity and quality found in each towing.

No. 1 Towing.

1. *Bosmina*..... 1
2. *Diatom*..... 1

No. 2 Towing at bottom.

1. *Nauplius*..... 3
2. *Bosmina*..... 2

No. 4 Towing.

1. *Ceratium longicorne*.....24
2. *Nauplius*..... 3
3. *Cyclops*..... 5
4. *Bosmina*.....11
5. *Daphnia*.....4

3. *Nematoda*	1
4. *Ceratium longicorne*	672

No. 3 Towing taken by pumping.

1. *Cypris*	4
2. *Diatoms*	5
3. *Difflugia*	1
4. *Ceratium longicorne*	10

No. 6 Towing.

1. *Bosmina*	11
2. *Nauplius*	9
3. *Ceratium longicorne*	68
4. *Rotifera skeleton*	1

No. 8 Towing.

1. *Cypris*	1
2. *Bosmina*	1
3. *Nematoda*	1

No. 5 Towing.

1. *Cypris*	1
2. *Rotifera*	2
3. *Bosmina*	28
4. *Nauplius*	4
5. *Cyclops*	7
6. *Ceratium longicorne*	80
7. *Difflugia*	3

No. 7 Towing.

1. *Nauplius*	10
2. *Bosmina*	14
3. *Arcella*	8
4. *Cylcops*	2
5. *Vorticella*	7
6. *Ceratium longicorne*	563

Our Birds in November.

BY BROTHER ALPHONSUS, C. S. C.

November is the month when the last of the summer residents and spring migrants depart for their winter homes. Fox Sparrows, Titlarks and Myrtle Warbles, among the migrants, are the last to leave us. And among the summer residents, the Robin, Kingfisher, Bronzed Grackle, Killdeer, Vesper Sparrow, Golden-crowned Kinglet and Logger-head Shrike are the latest to depart. The species that are most frequently seen in November are the Song Sparrow, Goldfinch, Cardinal, Biue Jay, Crow, Downy Woodpecker, Redheaded Woodpecker, White-breasted Nuthatch, Chickadee, Snowbird, Purple Finch and Tree Sparrow. Those that are less frequently observed are the Brown Creeper, Hell Diver, Prairie Horned Lark, and Mourning Dove.

Song Sparrow

Melospiza melodia

This favorite songster is quite hardy, and remains north in small numbers all winter. In November the bird may be heard calling near its summer haunts along the shores of lakes and streams; and occasionally on bright days, the cheery notes of its song will greet the bird-lover. Not infrequently the pedestrian will startle a

Song Sparrow near the edge of a lake, when the bird will fly across the water.

GOLDFINCH

Astragalinus tristis

In late autumn the Goldfinches gradually grow fewer and fewer in number, and finally no records will be made by the careful observer for days together. In the first part of the month these birds are found in small flocks, and may be readily known by the characteristic call-notes. By this time the Goldfinches have changed their bright summer plumage for the sober dress of winter.

BLUE JAY

Cyanocitta crestata

Hardly less striking in appearance than the Cardinal is the handsome Blue Jay. He gives the observer every opportunity to appreciate the beauty of his blue coat, for the bird often drops to the ground, or perches in a low tree or shrub. Here he almost deafens a person who may be close to him by his harsh call-note. The fine bell-like note of the Jay may be heard at any time of the year, but less often in autumn and winter.

DOWNY WOODPECKER

Dryobates pubesceno

This gentle bird may be seen quite frequently in November and also in winter. Usually alone, the Downy Woodpecker is never noisy like most of the other woodpeckers, but utters its note demurely while working on the bark of our forest or park trees. It would be interesting to know what amount of good one Downy Woodpecker does for our trees in the way of searching in the bark for the larvæ of injurious worms and insects.

WHITE-BREASTED NUTHATCH

Sitta carolinensis

This is the greatest acrobat among the bird tribe. It is always interesting to watch a Nuthatch climbing up or down the trunk of a tree. Both in woods and among park trees this useful bird may be found in winter or summer at work on the bark. More clever in climbing than the Chickadee, the Nuthatch can get at any part of a branch to examine it and find out whether there are any enemies hidden out of sight.

Crow

Corvus brachyrhynchos

The Crow is an interesting bird at all seasons of the year, but most interesting in the bleak days of late autumn. Then he will enter our groves singly or in small numbers, flying about noiselessly and occasionally cawing. Sometimes great flocks of Crows may be seen feeding in corn fields, where they often rise, fly for a short distance, and then they alight again.

Cardinal

Cardinalis cardinalis

The always striking Cardinal remains with us the year round, and is more common in autumn than at any other season of the year. He makes a beautiful picture perched in a bare apple tree in the orchard. Usually his call-note is first heard before one is aware of the bird's presence. The Cardinal does not whistle in November or during the winter months.

Red-Headed Woodpecker.

Melanerpes erythrocephalus

If you see any Red-headed Woodpeckers in November you may know that we shall have a mild winter. This is an infallible sign. Mr. John Burroughs published recently in the newspapers his opinion that we should have a severe winter, owing to the presence in Michigan of a number of Arctic birds supposed to be found there only in very cold weather. But I think the winter will be a mild one, for the Red-headed Woodpeckers are here in numbers.

Chickadee

Parus atricapillus

At no other time of the year are Chicadees so common as in the month of November. In fact I think they are more in evidence then than any other species of bird. Always confiding and easily approached, they utter their well known notes with snap and vigor. Their disposition suggests smartness, while their trim appearance adds to their attractiveness.

Snowbird

Junco hyemalis

The snowbirds or juncoes are our favorite winter birds. But they are more abundant in late fall than in winter. When the ground is covered with snow, the juncoes seem to retire farther

south, and only occasional flocks remain to eke out a scanty living in the snow. Always lively and chatty, the juncoes are a delight to the regular pedestrian.

TREE SPARROW

Spizella monticola

This species is probably the latest arrival of the northern migrants. Similar in plumage and in call-notes to the Field Sparrow, the Tree Sparrow comes to our latitude about the time the former leaves us. For this reason it is not easy to be always sure which species you may find at this particular season. Another drawback in the matter of indentifying the Tree Sparrow, is its scarcity at the time it first appears.

PURPLE FINCH

Carpodams purpurens

Late in autumn and in mild winters Purple Finches may be found in small flocks feeding on weed seeds. They loose their bright spring plumage before November, and are then difficult to distinguish from the English Sparrow. No longer is their sweet strain heard, but by a characteristic call-note, when known to the observer, is the easiest way of indentifying the species.

Notes on Variation in Chicory.

N. M. GRIER, PH. D.

Chicory, (*Cichorim Intybus, L.*), has appeared in this section of the Shenandoah Valley within the past few years. Recently the writer has had opportunity to observe its variation, especially with regard to floral structures.

Flowers. Of the 412 specimens examined from various localities and the frequency of whose rays were plotted, those with 14 were found to be most numerous with a total of 76 cases. The curve of variation based on the data obtained was remarkable normal and free from 'skewness' in every respect. Minor modes were obtained for 13 rays in 64 cases at 15 in 65 cases. The least number of rays found was six, the greatest 22.

It appeared that as a whole, the rays were most numerous on heads obtained where the exposure was an open one, such as the

roadside on a level stretch of ground, while they were most numerous in the leading classes of 13, 14, 15 rays when these were taken from hillsides consisting largely of rocky or infertile ground. In about 20 of the 412 specimens the heads were solitary, and usually on elongated branches. Of the total number one was white in color, 2 pink, and the others various shades of blue.

Involucre. 238 of 259 outer involucres possessed 5 bracts, but there were 12 specimens with 6 bracts. The least number obtained here was 4, the greatest was 8. Greater variation was encountered in the inner portion. Here there were 140 cases of 8 bracts, 53 of 7, 47 of 9. Least number obtained was 6, greatest was 10.

With its rather extended distribution, and consisting as it does of a moderate number of floral parts, chicory should make where readily available, convenient laboratory material for the study of variation in classes of Biology. Unopened buds will flower until 2 or 3 days after having been brought into the laboratory.

Hollins College, Hollins, Va.

Our Birds in December.

BY BROTHER ALPHONSUS, C. S. C.

It may be interesting to compare the records made by the writer for two Decembers—one (1918) a mild month; the other (1919) partly a cold month. With most of the species the number records was somewhat larger for December, 1918. On the other hand the Downy Woodpecker had notably more records for December 1919.

The records for the two years under comparison would seem to indicate that a difference in the temperature does not necessarily show there are fewer species found when the weather is cold. All the birds except the Hairy Woodpecker and Screech Owl were seen in both Decembers.

The cold weather in December, 1919, moderated after the middle of the month, and then most of the re cords for the Cardinal and the Purple Finch were made.

DECEMBER 1918.

Hairy Woodpecker, 6, 9, 28.
Downy Woodpecker, 6, 15.

Red-headed Woodpecker, 1, 2, 6, 7, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 22, 23, 30.
Goldfinch, 11, 12, 13.
White-breasted Nuthatch, 1, 3 to 19, 21, 23, 25 to 29.
Blue Jay, 1 to 7, 10 to 13, 15, 17, 18, 19, 29, 30.
Crow, 2, 11, 15, 16, 19, 23, 25, 26, 28, 29, 31.
Chickadee, 3, 5 to 9, 11, 13, 14, 15, 16, 18, 29.
Song Sparrow, 3, 5, 6, 8, 9, 10, 13, 14, 16, 17, 18, 19, 25, 26, 27.
Cardinal, 8, 12, 14, 15, 16, 18, 22, 27, 28.
Snowbird, 1, 6 to 15, 17 to 20, 23, 24, 27, 28, 30.
Tree Sparrow, 5, 6, 9, 14, 15, 17, 18, 23, 26 to 29.
Brown Creeper, 1, 6.
Purple Finch, 7, 25, 27, 28, 30.
Mourning Dove, 26, 27.
Total number of species seen, 15.

DECEMBER, 1919.

Downy Woodpecker, 2, 3, 5, 8, 11, 12, 13, 21, 22, 28.
Red-headed Woodpecker, 2, 5, 7, 8, 9, 12, 14, 16, 17 ,19, 20, 21, 26, 27, 31.
Goldfinch, 14.
White-breasted Nuthatch, 1 to 5, 7, 8, 9, 12 to 16, 19, 20, 22, 24, 25, 31.
Blue Jay, 5, 7, 8, 9, 11, 12, 13, 18 to 22, 26, 28, 31.
Crow, 2, 7, 9, 26.
Chickadee, 1 to 5, 8, 12, 16, 17, 20, 21, 25, 27.
Song Sparrow, 1, 2, 3, 9, 12, 14, 25.
Tree Sparrow, 23.
Cardinal, 15, 19, 23, 30.
Snowbird, 1, 2, 3, 6, 7, 11, 16, 26.
Brown Creeper, 9, 27.
Purple Finch, 3, 19, 25.
Mourning Dove, 2.
Screech Owl, 16.
Total number of species seen, 15.

18,

27.

21,

22,